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NOISE SPECTRA OF THE BELL OH-13-T HELICOPTER

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AND DEVELOPMENT COMMAND

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ABSTRACT

Overall sound pressure levels were measured and an octave-band analysis was made of the internal and external noise of the Bell OH-13-T helicopter. The results of the tests show that the noise level in the OH-13-T is not considered to be significantly different than the levels that have been recorded in the OH-13-H helicopter. Ear plugs and efficient earmuffs or helmets will attenuate the noise to levels that are considered to be safe for operations of long durations.

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INTRODUCTION

The Bell OH-13-T,a single engine helicopter recently acquired by the U. S. Army, was made available to the U. S. Army Aeromedical Research Unit for measurement and recording its internal and external acoustic environment under operating conditions. The OH-13-T is powered by a Type 04-35 Lycoming engine that drives a single main rotor and an antitorque rotor system. The military rated horsepower of the engine is 270 for take-off and 220 for continuous operation. This helicopter is also equipped with a supercharger for high altitude operation.

PROCEDURE

Internal sound pressure levels, in the cockpit, of the full audio spectra (FAS) and ten octave-bands were measured by a passenger seated beside the pilot on the ground and during flight. The range of engine revolutions per minute was from 2300 rpm to 3200 rpm. The rotor rpm was less than the engine rpm by a factor of 10 under all test conditions.

At the beginning of the test it was determined that there were no significant differences between sound pressure levels at positions near the pilot and the passenger. Therefore, only one set of readings were taken near the passenger.

For the external sound pressure levels measurements were taken while the pilot operated the engine at 2300 rpm; a power setting typical of a high percent of ground operations. Five positions, 0^{o}, 45^{o}, 90^{o}, 135^{o}, 180^{o} with a constant radius of 50 feet were measured. Zero degrees was the midline of the aircraft forward of the pilot.

INSTRUMENTATION

The sound pressure levels were measured with Brüel and Kjaer sound level meter type 2203, a Brüel and Kjaer 4132 condenser microphone and a Brüel and Kjaer type 1613 filter set. The calibration of the sound level meter was done with a Brüel and Kjaer type 4220 pistonphone. All measurements were made on an unweighted or linear scale.

In the tables and figures where octave-band sound pressure levels are listed the center frequencies (f_c) are defined as follows: The 3 db attenuation cutoff frequencies below and above the center frequency on a logarithmic scale are $f_c / \sqrt{2}$ and $f_c \times \sqrt{2}$ respectively. The filters yield a 40 db per octave slope attenuation from the cutoff frequencies.

RESULTS AND DISCUSSION

Table I contains the sound pressure levels measured in the cockpit. For the lowest rpm of 2300 the overall sound pressure level of the full audio spectrum was 104 db. Of the ten octave-bands the four with center frequencies (f_c) of 31.5 cps, 125 cps, 250 cps and 500 cps had sound pressure levels greater than 90 db.

For the condition of 3200 rpm the overall sound pressure level of the full audio spectrum was 116 db. Eight of the ten octave-bands had sound pressure levels which were equal to or above 90 db. The two high frequency bands with center frequencies of 8000 cps and 16000 cps were below 90 db. See Figure 1 for a comparison of the spectra contours between the lowest and the highest rpm.

Table II contains the data concerning sound pressure levels measured on a radius of 50 feet around the helicopter. In general, there was a gradual increase of sound pressure level from 0° to 180°. For the overall level of the full spectrum this was a 6 db change. Figure 2, a plot of sound pressure level of various bands as a function of angular position, depicts the fact that there was little change of the character of the noise around the helicopter.

The area between the two spectra contours of Figure 1 represent the acoustic spectra in which personnel inside the OH-13-T are subjected. All portions of the spectra below 4000 cps may be above 90 db SPL. Also, the results show that the overall sound pressure level and the octave band with 125 cps center frequency was over 90 db at five angular positions 50 feet from the helicopter.

The U. S. Army Technical Bulletin, TB MED 251, of 25 January 1965, requires that personnel wear ear protection who are subjected to relatively steady broad-band noises of sound pressure levels of 92 db in the octave-band 150-300 cps and 85 db at all higher octave-bands through 9600 cps. The sound pressure levels measured in and around the OH-13-T are above the specified limits provided in TB MED 251 and do require that measures be taken for conservation of hearing for both maintenance and operating personnel. There is no aspect of the noise spectra

TABLE I

Full Audio Spectra (FAS) and Octave-Band Sound Pressure Levels Measured in the Bell OH-13-T Helicopter Under Various Power Conditions.

	Eng. RPM 2300	Eng. RPM 3100	Eng. RPM 3200
FAS	104 db	115 db	116 db
Octave-Bands			
31.5 cps *f_c	90 db	107 db	109 db
63 cps f_c	87 db	101 db	102 db
125 cps f_c	97 db	105 db	107 db
250 cps f_c	97 db	94 db	97 db
500 cps f_c	90 db	94 db	96 db
1000 cps f_c	89 db	97 db	97 db
2000 cps f_c	82 db	93 db	94 db
4000 cps f_c	79 db	88 db	90 db
8000 cps f_c	74 db	83 db	83 db
16000 cps f_c	64 db	70 db	70 db

*Octave-band center frequency

TABLE II

Sound Pressure Levels of the Full Audio Spectrum and Octave-Band at Five Angular Positions at a Radius of 50 Feet Around the Bell OH-13-T Helicopter Operating at 2300 rpm.

		0°	45°	90°	135°	180°
FAS		94 db	95 db	98 db	99 db	100 db
Octave-Bands						
63	cps *f_c	81 db	82 db	82 db	78 db	83 db
125	cps f_c	93 db	93 db	96 db	97 db	98 db
250	cps f_c	84 db	84 db	88 db	90 db	91 db
500	cps f_c	78 db	78 db	81 db	84 db	87 db
1000	cps f_c	73 db	78 db	78 db	81 db	80 db
2000	cps f_c	70 db	72 db	74 db	75 db	74 db
4000	cps f_c	71 db	72 db	74 db	79 db	76 db
8000	cps f_c	72 db	78 db	80 db	82 db	84 db
16000	cps f_c	67 db	68 db	67 db	67 db	72 db

*Octave-band center frequency

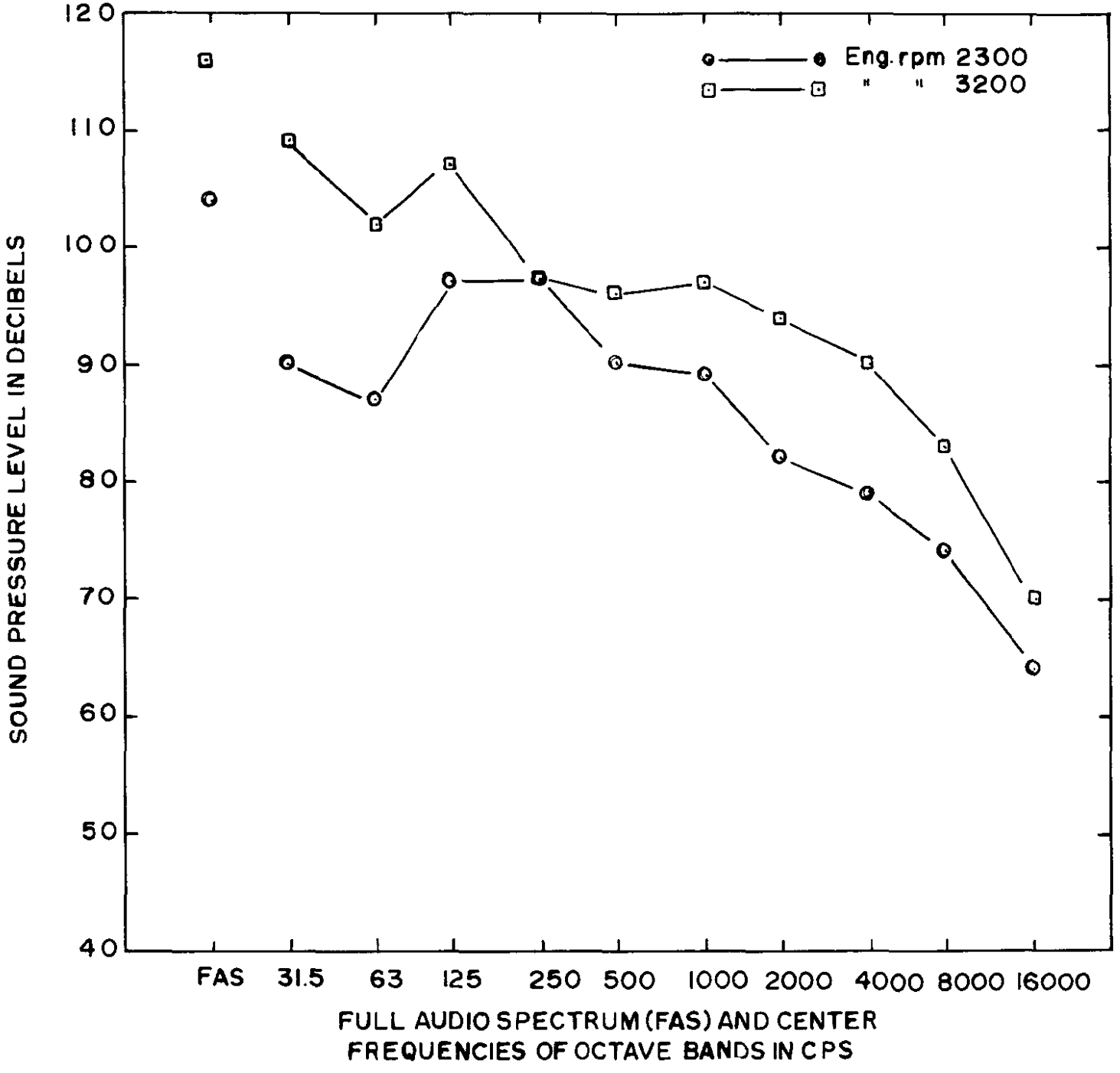
120
110
100
90
80
70
60
50
40
SOUND PRESSURE LEVEL IN DECIBELS
Eng. rpm 2300
" " 3200
FAS
31.5
63
125
250
500
1000
2000
4000
8000
16000
FULL AUDIO SPECTRUM (FAS) AND CENTER
FREQUENCIES OF OCTAVE BANDS IN CPS

FIGURE 1

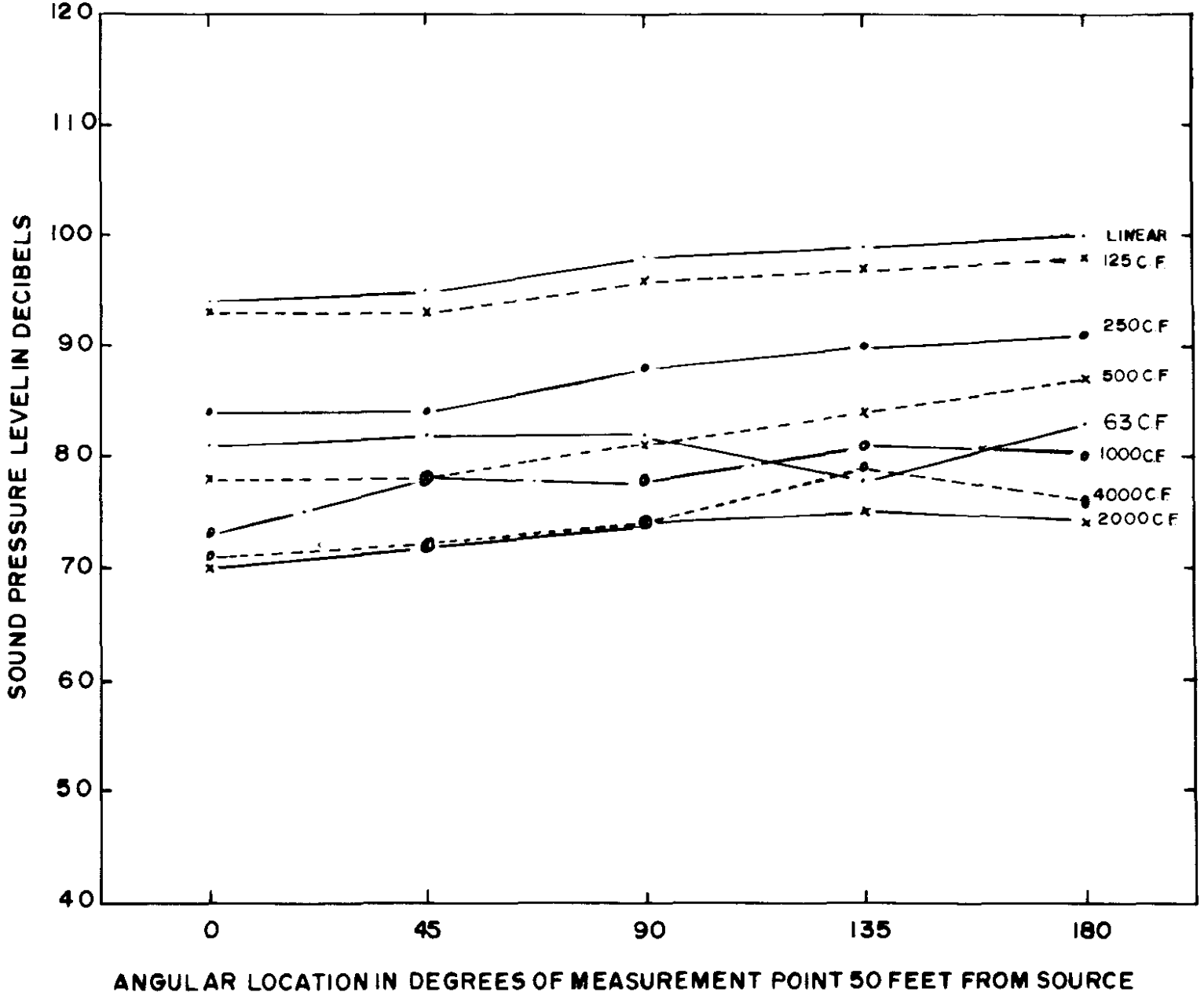
120
110
100
90
80
70
60
50
40
SOUND PRESSURE LEVEL IN DECIBELS
LINEAR
125 C.F.
250 C.F.
500 C.F.
63 C.F.
1000 C.F.
4000 C.F.
2000 C.F.
0
45
90
135
180
ANGULAR LOCATION IN DEGREES OF MEASUREMENT POINT 50 FEET FROM SOURCE

FIGURE 2

produced by the OH-13-T that is considered to be more hazardous than the noise encountered in the OH-13H helicopter. Sound spectra of the OH-13H given in USAARU Report No. 64-1 shows that there is little difference between the spectra contours of the two aircraft.

CONCLUSIONS

An octave-band analysis of the internal and external noise of the Bell OH-13-T helicopter was done under various power conditions. The results of these noise measurements have led to the following conclusions.

1. The noise levels of the Bell OH-13-T are high enough to require hearing conservation measures as stated in TB MED 251 of 25 January 1965.

2. The noise levels and spectra are not considered to be extra hazardous.

3. Normal hearing conservation procedures such as the use of earplugs, efficient earmuffs or helmets will attenuate to noise to a safe level.